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(54) Improvements in telemators

(57) A hydraulic actuator has a master piston and cylinder arrangement (10 and 11) and a slave piston and cylinder arrangement (18 and 19) connected by passageways (17 and 25), each leading from separate chambers (15 and 16) formed between the stepped contacting surfaces of the master piston (10) and cylinder (11). Fluid expelled from the chambers may be diverted away from the slave piston and cylinder arrangement by indexing valves (20 and 26) so that the ratio of slave piston output displacement to master piston displacement may be controlled.

The valves may be electrically operated to provide a fast response to varying load demands.

Fig.1.

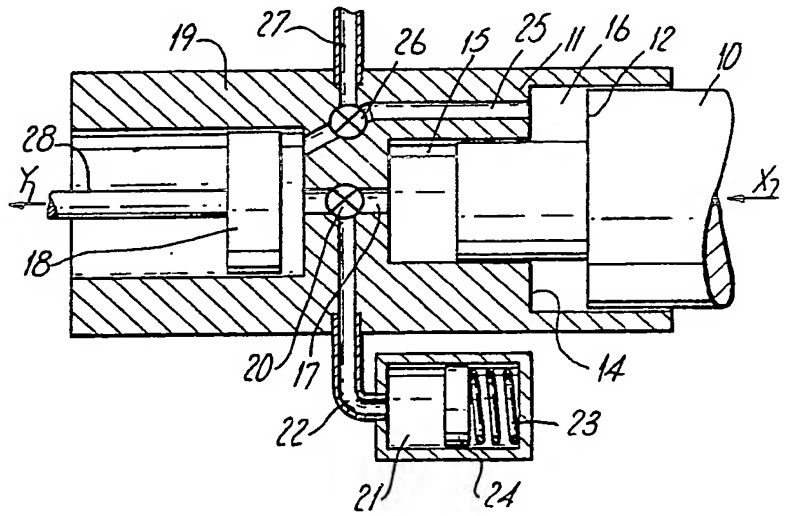

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Fig.1.

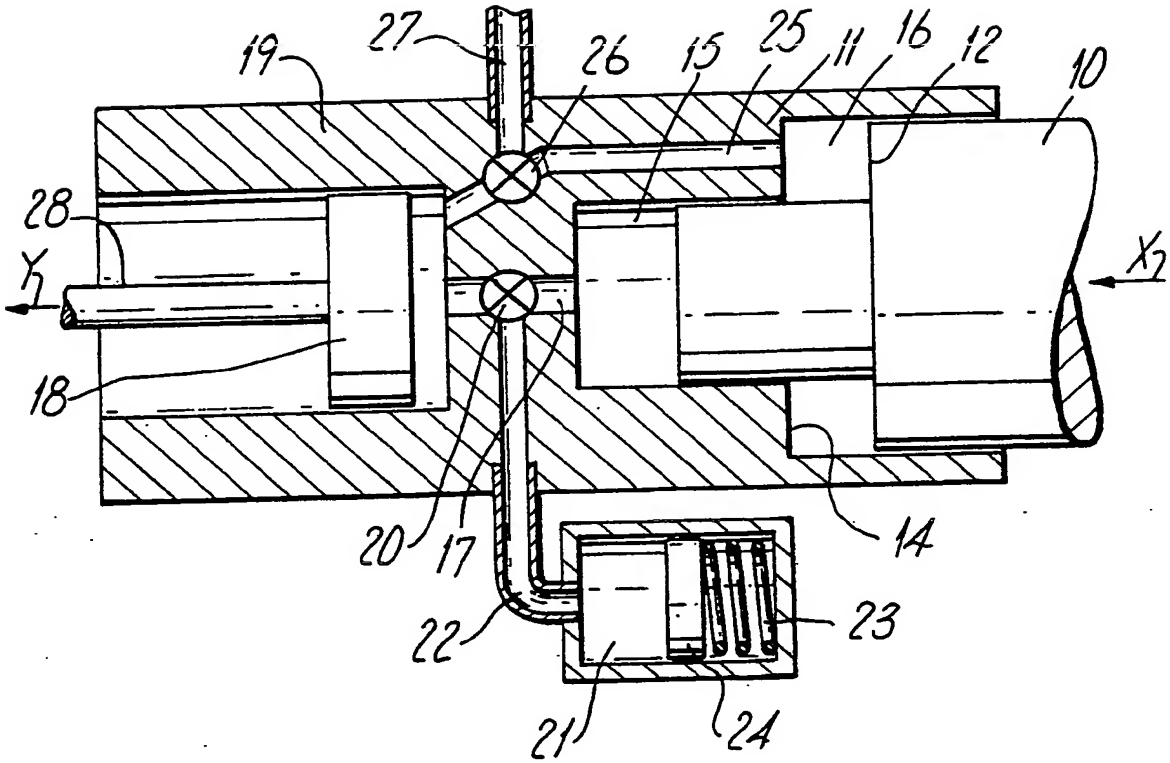
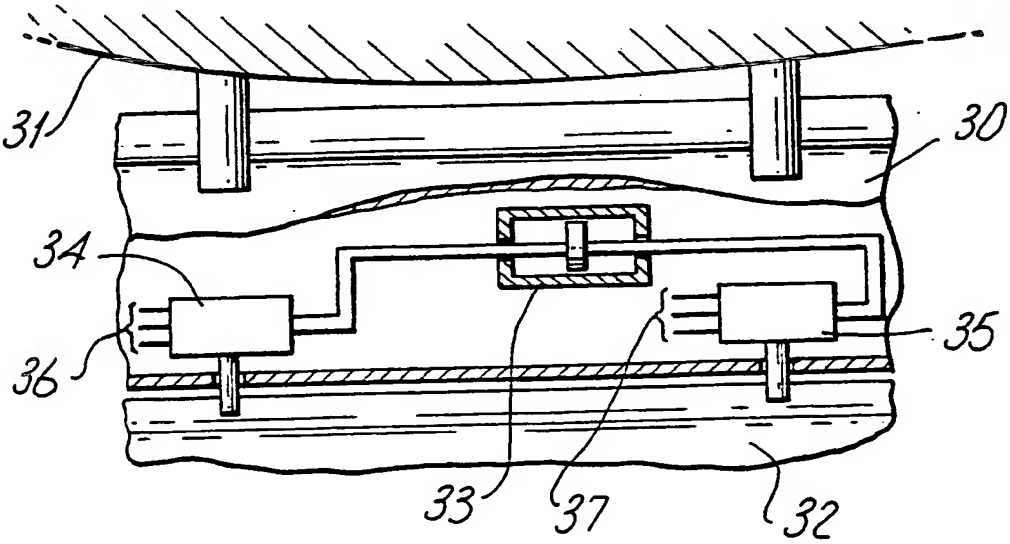


Fig.2.



SPECIFICATION

Improvements in or relating to hydraulic actuators

This invention relates to hydraulic actuators.

A hydraulic actuator may be used to cause an output displacement in response to an input displacement. For example, a hydraulic actuator may be used in an ejection release unit to produce a displacement to eject a store from an aircraft.

According to the present invention a hydraulic actuator includes a master piston and cylinder arrangement, the contacting surfaces of the piston and cylinder being stepped to define a plurality of chambers there between, a plurality of valved passage ways connecting the chambers with a slave piston and cylinder arrangement each valve having a first position such that fluid expelled from a chamber passes into the slave cylinder, and a second position such that the valve may be indexed to divert expelled fluid away from the slave cylinder.

It will be appreciated that in a hydraulic actuator in accordance with the present invention the ratio of the slave piston displacement to the master piston displacement may be controlled by indexing the valves. It will further be appreciated that if two or more such actuators have their master pistons arranged to receive a substantially equal applied force, the ratio of the various output displacements may be similarly controlled.

Preferably a reservoir is provided to receive fluid diverted away from a connecting passageway, the reservoir may be a compressible chamber to which a compressing bias is applied so that fluid may be returned to the master cylinder as the piston is retracted after actuation to allow repeated actuation. The master and slave cylinders and connecting passageways may advantageously be formed integrally, although a hydraulic actuator in which a master piston and cylinder arrangement is connected via pipework to a remote slave piston and cylinder arrangement is within the scope of the present invention.

In order that features and advantages of the present invention may be appreciated more fully embodiments will now be described, by way of example only, with reference to the accompanying diagrammatic drawings of which:

Fig 1 represents a hydraulic actuator in accordance with the present invention.

Fig. 2 represents an ejection release unit including hydraulic actuators in accordance with the present invention.

In a hydraulic actuator (Fig 1) a master piston and cylinder arrangement comprises a piston 10 and a cylinder 11. The contacting surfaces of the piston 10 and the cylinder 11 are stepped at 12 and 14 respectively to define a first chamber 15 and an annular second chamber 16. A passageway 17 connects the first chamber 15 with a slave piston and cylinder arrangement comprising a piston 18 and a cylinder 19. A valve 20 is situated in the passageway 17, the valve 20 having a first position to allow fluid expelled from the chamber 15 to enter the slave cylinder 19 and a second position such that the valve 20 may be indexed to divert expelled fluid into a compressible reservoir 21 along a passageway 22. A compressing bias is applied to the reservoir 21 by means of a spring 23 acting on a piston 24 or alternatively by gas pressure. A passageway 25 similarly connects the second chamber 16 with the slave cylinder 19 via a valve 26 which may be indexed between a first position to allow fluid expelled from the second chamber 16 to enter the cylinder 19 and a second position to divert the expelled fluid into a reservoir (not shown in the figure) via a passageway 27.

The operation of the above embodiment will now be described. It is assumed that the piston 10 is initially retracted from the cylinder 11 and that the slave piston 18 is positioned to actuate a load on a shaft 28. (This is the situation shown in Fig 1).

An actuating force is applied to the stepped piston 10 as shown at X. Fluid displaced from the chambers 15 and 16 may either enter the slave cylinder 19 or be diverted into a reservoir, dependent upon the position of the valves 20 and 25 respectively. If, for example, both valves are in their first position all the fluid expelled from the master cylinder 11 reaches the slave cylinder 19 to displace the piston 18 in the direction Y. If, alternatively, valve 26 is at its first position and valve 20 at its second position only that fluid expelled from the second chamber 16 displaces the piston 18. Fluid displaced from the first chamber 15 is diverted into the reservoir 21, overcoming the compressing bias supplied by the spring 23. Thus the combined setting of the valves 20 and 25 controls the ratio of the displacement of the slave piston to the displacement of the master piston. After actuation, the slave piston 18 may be reset and the master piston 10 retracted for subsequent actuation, any fluid in the reservoirs (such as reservoir 21) being returned to the master cylinder 11.

Means for indexing the valves 20 and 25 is well known and will not be discussed here, however the valves may advantageously be electrically operated.

It will be realised that in a hydraulic actuator in accordance with the present invention the number of chambers defined by the stepped master piston and cylinder arrangement may be selected to achieve the degree of control required. It will further be realised that the control available may in some applications be improved by providing chambers of different volumes such that the rate of expulsion of fluid from each chamber is weighted. The weighting may for example, accord with a binary law, the largest chamber having a volume proportional to 2^{N-1}, the next chamber having a volume proportional to 2^{N-2} and so on, the smallest chamber having a volume proportional to 2^{0}, where N is the number of chambers. Binary weighting may be particularly advantageous where control is effected by digital electronic logic circuitry.

Hydraulic actuators in accordance with the present invention may be included in an Ejection Release Unit (ERU) for release of a store from an aircraft. An ERU 30 (Fig 2) is suspended from an aircraft wing 31. A store 32 is suspended by means well known in the art (not shown in the figure) from the ERU 30. Gas pressure from a pressurized reservoir or generated by burning a charge in a chamber 33 results in a force being transmitted via rod linkages 39 and 40 to hydraulic actuators 34 and 35 in accordance with the present invention. The actuators 34 and 35 are arranged to cause ejection of the store 32 from the aircraft by producing a downward output displacement by the mechanism discussed above.

During ejection the forces on the store vary widely according to aircraft motion. Mechanically linking prior art hydraulic actuators in this way constrains the two actuators to follow a predetermined output displacement relationship despite variation in forces applied by the store to the actuators. The use of hydraulic actuators in accordance with the present invention provides a variable output displacement relationship so that the store 32 can be given a predetermined angular velocity at ejection. Control may be remote via signals on control line groups 36 and 37, or alternatively may be manually present before flight.

CLAIMS

The matter for which the applicant seeks protection is:

1. A hydraulic actuator including a master piston and cylinder arrangement, the contacting surfaces of the master piston and cylinder being stepped to define a plurality of chambers, and a plurality of valved passageways connecting the chambers with a slave piston and cylinder arrangement, each valve having a first position such that fluid expelled from a chamber passes into the slave cylinder, and a second position such that the valve may be indexed to divert expelled fluid away from the slave cylinder.

2. A hydraulic actuator as claimed in claim 1 and wherein the ratio of slave piston displacement to master piston displacement may be controlled by indexing the valves.

3. A hydraulic actuator as claimed in claim 1 or claim 2 and wherein a reservoir is provided to receive fluid diverted away from a connecting passageway.

4. A hydraulic actuator as claimed in any one proceeding claim and wherein the master and slave cylinders and interconnecting passageways are of unitary construction.

5. A hydraulic actuator as claimed in any one preceeding claim and wherein each chamber is of predetermined volume such that the rate of expulsion of fluid from each chamber is weighted.

6. A hydraulic actuator as claimed in claim 6 wherein the weighting accords with a binary law.

7. A hydraulic actuator substantially as herein described with reference to the accompanying drawings.

8. An ejection release unit including a hydraulic actuator as claimed in any preceding claim.

9. An ejection release unit substantially as herein described with reference to Fig 2 of the accompanying drawings.

10. Hydraulic apparatus including a plurality of hyrdaulic actuators as claimed in any of claims 1 to 7 wherein the master pistons of the actuators are arranged to receive a substantially equal applied force.

11. Hydraulic apparatus as claimed in claim 10 and wherein the ratio of the output displacements of the slave cylinders may be controlled by indexing the valves.

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